What is claimed is:

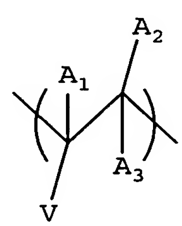
1. A polyelectrolyte film comprising an interpenetrating network of a net positively charged polymer and a net negatively charged polymer, wherein the net positively charged polymer, the net negatively charged polymer, or both contain polymer repeat units with at least two fluorine atoms.

2. The polyelectrolyte film of claim 1 wherein the net positively charged polymer and the net negatively charged polymer are independently selected from the group consisting of polyolefins, polyamines, polyamides, polyethers, polyesters, polyimides, polysulfones, polyaryls, polyphenols, polyaramides, and copolymers thereof.

3. The polyelectrolyte film of claim 1 wherein the net positively charged polymer and the net negatively charged polymer are polyolefins having vinyl groups.

4. The polyelectrolyte film of claim 3 wherein the vinyl group is an allyl group.

5. The polyelectrolyte film of claim 2 wherein the repeat unit has the structure:



wherein A_1, A_2, and A_3 are each independently $-(CH_2)_mH$ or $-(CH_xF_{2-x})_nF$ where m and n are independently 0 to 12, x is 0, 1, or 2; and each V is independently selected from the group consisting of:

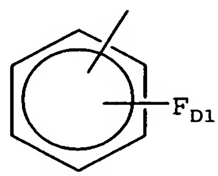
fluorinated hydrocarbons having the formula:
$-(CH_2)_p(CF_2)_qF$; $-(CH_2)_p(CF_2)_qCOOH$; $-(CH_2)_p(CF_2)_qOPO_3^-$; $-(CH_2)_p(CF_2)_qSO_3^-$; $-(CH_2)_p(CF_2)_qOSO_3^-$; $-O(CH_2)_p-(CF_2)_q-F$; or

$-O(CH_2)_p(CF_2)_q-SO_3^-$;

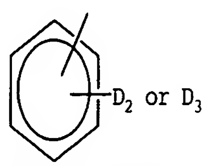
fluorinated amides having the formulae $-CONB_1$ wherein B_1 is $-(CH_2)_p(CF_2)_qF$; $-(CH_2)_p(CF_2)_qCOOH$; $-(CH_2)_p(CF_2)_qOPO_3^-$; $-(CH_2)_p(CF_2)_qSO_3^-$; or $-(CH_2)_p(CF_2)_qOSO_3^-$;

fluorinated esters having the formulae $-COOC_1$ wherein C_1 is $-(CH_2)_p(CF_2)_qF$; $-(CH_2)_p(CF_2)_qCOOH$; $-(CH_2)_p(CF_2)_qOPO_3^-$; $-(CH_2)_p(CF_2)_qSO_3^-$; or $-(CH_2)_p(CF_2)_qOSO_3^-$;

fluorinated phenyl groups having the formulae:

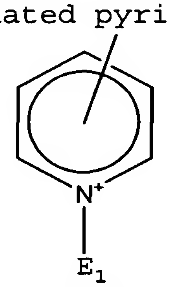


wherein D1 is 2 to 5; or



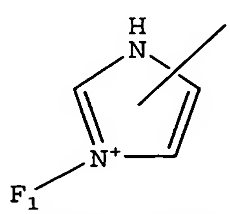
wherein D_2 is $-(CH_2)_p(CF_2)_qF$ or $-O(CH_2)_p(CF_2)_qF$;

fluorinated pyridiniums having the formulae:



wherein E_1 is $-(CH_2)_p(CF_2)_qF$;

fluorinated imidazoliums having the formulae:



wherein F_1 is $-(CH_2)_p(CF_2)_qF$;

fluorinated quaternary nitrogens having the formulae

$-N^{+}G_1G_2G_3$ where G_1, G_2, and G_3 are each independently $-(CH_2)_p(CF_2)_qF$ or $-arylF_z$ wherein z is 2 to 8;

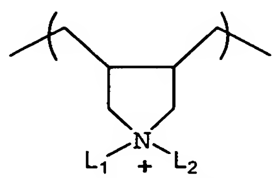
fluorinated sulfoniums having the formulae $-S^{+}H_1H_2$ where H_1 and H_2 are independently $-(CH_2)_p(CF_2)_qF$; Or $-arylF_z$ where z is 2 to 8; and

fluorinated phosphoniums having the formulae $-P^{+}J_1J_2J_3$ where J_1, J_2, and J_3 are independently: $-(CH_2)_p(CF_2)_qF$; or $-arylF_z$ where z is 2 to 8;

p is 0 to 6 and

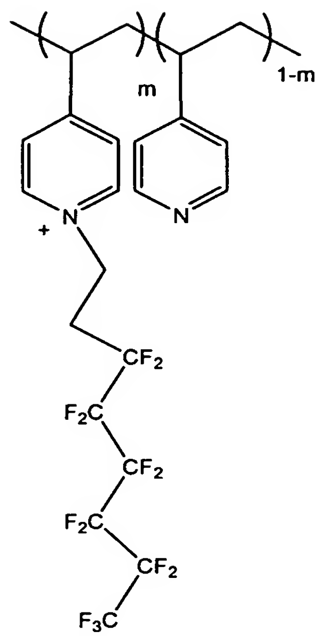
q is 1 to 21.

6. The polyelectrolyte film of claim 2 wherein the polymer repeat unit comprises an allyl group having the structure:



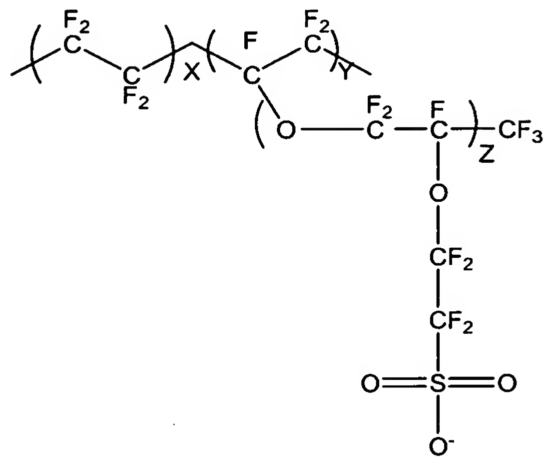
wherein L_1 and L_2 are $-(CH_2)_p(CF_2)_qF$, p and q are independently selected for L_1 and L_2, and p is 0 to 6 and q is 1 to 21.

7. The polyelectrolyte film of claim 1 wherein the net positively charged polymer has the structure:



wherein m is a mole fraction from about 0.1 to about 1.0.

8. The polyelectrolyte film of claim 1 wherein the net negatively charged polymer has the structure:



wherein X is from about 6 to about 10, Y is about 1, and Z is from about 1 to about 3.

9. The polyelectrolyte film of claim 1 further comprising particles having a size in the range of about 1 nanometer to about 10 micrometers.

10. The polyelectrolyte film of claim 9 wherein the particles are selected from the group consisting of silicon dioxide, aluminum oxide, titanium dioxide, iron oxide, zirconium oxide, vanadium oxide, clay minerals, carbon fibers, carbon nanotubes, and charged fluorinated particles.

11. The polyelectrolyte film of claim 10 wherein the particle is the clay mineral, and the clay mineral comprises attapulgite clay.

12. A film comprising a fluorinated charged polymer and a fluorinated charged particle, wherein the charge of the polymer is opposite that of the charge of the particle.

13. The film of claim 12 wherein the fluorinated charged particle comprises polytetrafluoroethylene.

14. A method for controlling the hydrophobicity of a surface of an article, the method comprising alternately depositing solutions comprising net positively charged polymers and net negatively charged polymers onto the surface of the article to form a polyelectrolyte film of an interpenetrating network of net positively charged polymers and net negatively charged polymers on the surface of the article, wherein the net positively charged polymer, the net negatively charged polymer, or both contain polymer repeat units with at least two fluorine atoms.

15. The method of claim 14 wherein the solutions are deposited by spraying, immersing, or brushing the surface of the article with solutions comprising the net positively charged polymers and net negatively charged polymers.

16. The method of claim 15 wherein the solution comprises the net positively charged polymers and net negatively charged polymers dissolved in supercritical CO_2.

17. The method of claim 14 wherein the article is selected from the group consisting of glass, plastics, paint, metal, and ceramic.

18. The method of claim 14 wherein the article is a construction material selected from the group consisting of brick, tile, grout, wood, concrete, and stone.

19. The method of claim 14 wherein the article is a soft material said soft material selected from the group consisting of carpet, garment, cloth, fabric, upholstery, and leather.

20. The method of claim 19 wherein the article is carpet, said carpet comprising fibers selected from the group consisting of polyester, polyolefin, polyamide, and copolymers thereof.

21. The method of claim 14 wherein the article is a fiber optic or waveguide, and the polyelectrolyte film is used as a cladding on the surface of the fiber optic or waveguide.

22. The method of claim 14 wherein the article is a metal selected from the group consisting of steel or aluminum, and the polyelectrolyte film is coated on the surface of the metal to prevent the corrosion of the metal.

23. The method of claim 14 wherein the article is a fuel cell and the polyelectrolyte film is used as a proton exchange membrane.

24. The method of claim 23 wherein the polyelectrolyte film has a thickness of less than 1 micrometer.

25. The method of claim 24 wherein the polyelectrolyte film further comprises small fluorinated counterions.

26. The method of claim 24 wherein the small fluorinated counterions are selected from the group consisting of perfluoroalkanesulfonic acids and perfluoroalkanecarboxylic acids.

27. The method of claim 23 wherein the polyelectrolyte film is formed on the surface of a film of poly perfluorinated sulfonated ionomer, wherein the poly perfluorinated sulfonated ionomer film has a thickness between 10 micrometers and 1000 micrometers.

28. A thin film of claim 1 used for the purpose of reducing friction at a surface.

29. A thin film of claim 1 used for the purpose of reducing friction as in claim 30. Said surface selected from the group metals, plastic, semiconductor, metal oxide.

30. A thin film of claim 1 on the surface of, and in contact with, a rotating disc magnetic storage medium ("fixed disc").

31. A thin film of claim 1 on the surface of, and in contact with, a rotating disc magnetic storage medium ("fixed disc"), and a further film of fluorinated small molecule or fluorinated oligomer in contact with said thin film of claim 1.

32. A thin film of claim 1 formed between two contacting, moving metal surfaces.

33. A thin film of claim 1 formed between two contacting, moving metal surfaces, said film formed by the addition of particles of complexed fluorinated polyelectrolytes.

34. A motor oil comprising particles of complexed fluorinated polyelectrolytes, said oil lubricating the moving metal parts of said motor.

35. A motor oil comprising particles of complexed fluorinated polyelectrolytes, said oil lubricating the moving metal parts of said motor, said oil further comprising fluorinated polymer.

36. A thin film of claim 1 forming an intermediate layer between an electrically conductive contact and a thin film of medium, said medium emitting light on passage of an electrical current.

37. A thin film of claim 1 forming an intermediate layer between an electrically conductive contact and a light emitting medium, said contact injecting electrons into said medium.

38. A thin film of claim 1 forming an intermediate layer between an electrically conductive contact and a light emitting medium, said medium comprising a conjugated polymer.